of cloud being carried down in streamers, which in turn soon disappear. In fact, these clouds, streamers and all, disappear by evaporation in about 30 to 40 minutes after the descending movement begins.

TORNADOES IN KANSAS.

By S. D. FLORA, Observer, U. S. Weather Bureau.

[Dated: Weather Bureau, Topeka, Kans., Dec. 18, 1915.]

Kansas has been so commonly considered the tornado State of the country that the term "Kansas cyclone" has almost become a part of the spoken English language, but this idea is as misleading as the use of the word "cyclone" to designate what should properly be called a *tornado*, that is, an exceedingly violent whirling storm of small diameter, with a pendant, funnel-shaped cloud.

It seems that a large part of this undesirable reputation of the State has been the result of undue publicity given such spectacular storms by the early settlers and continued by the activities of later disseminators of news.

That tornadoes do occur in the State practically every year and sometimes several within the same year can not be denied, but it should be considered that, while the area of the State exceeds 80,000 square miles, the path of an average tornado does not cover more than 25 square miles and many are a great deal smaller, so that one can generally be represented by a pin scratch less than an inch long on a map of the State of the size usually given in an atlas.

In a report on tornadoes of the United States for the eight years, 1889–1896, which is the most complete of the kind published, Prof. A. J. Henry [1] of the Weather Bureau has published data indicating that the total number of tornadoes in Kansas is somewhat greater than the number in any other State. When the relative areas are considered, however, the number of tornadoes in Kansas per unit area is practically the same as the corresponding number for Iowa and is but slightly greater than the number for Illinois, yet neither of these States has Kansas's reputation of being a tornado State. Prof. Henry in the same report has also deduced that even in the States where such storms occur most frequently "the probability that any area 100 miles square will be visited by a tornado in any year is generally less than certainty," and further, "for any specific area or farm of 1 square mile the probability [of being visited by a tornado] is less than one-sixteenth of 1 per cent per century." [2]

During the 10 years, 1889–1896 and 1914–15, for which definite information regarding the destruction by tornadoes is available, the average annual number of deaths in Kansas directly due to these storms is 14, or less than the number of deaths by lightning as shown by the mortality statistics of the State Board of Health, and much less than the number caused by any disease of common occurrence in the State. The average property loss for the period, even though it was almost doubled by the recent tornado at Great Bend, is insignificant when compared with the total wealth of the State or the annual losses by flood and hail, yet neither of these has attracted the notice given the damage inflicted by tornadoes.

The months of greatest frequency of tornadoes in the State are indicated by Table 1 compiled from the report of Lieut. John P. Finley [3] covering the years 1859–1887, the report of Prof. A. J. Henry covering the period 1889–1896, and the monthly reports of the Kansas section for the years 1914 and 1915.

TABLE 1.—*Total number of tornadoes, by months, reported in Kansas, 1859–1887, 1889–1896, 1914–15.*

January	0
February	1
March	16
April	41
May	66
June	54
July	20
August	15
September	8
October	3
November	4
December	0
Entire period	228

With the present available data it is idle to speculate whether any part of the State is more likely to be visited by these storms than any other part. The report of Lieut. Finley, while it covers a long period of time, is admittedly incomplete, being obtained "from all available sources" years after many of the storms had occurred, which means that many tornadoes might have occurred in sparsely settled communities during the early part of the record without having been reported; the report of Prof. Henry and those of the years 1914–15 cover too short a period to shed much light on this question.

Present knowledge of the cause of these storms discredits the idea that their formation is favored or hindered by such slight differences in topography as exist in a State as comparatively level as Kansas. Also there is no reason to believe they are becoming any more or less frequent than formerly. It is probable losses due to their destructive effects will increase as the land becomes more thickly settled, but not necessarily in proportion to the total population and wealth of the State.

The following Tables 2, 3, and 4 give a record of tornadoes in Kansas for all the years for which data are at present available.

[1] Tornadoes, 1895–96, by Alfred J. Henry, p. xxiii–xl, charts I–VIII. (Report of the Chief of the Weather Bureau, 1895–96. Washington, 1896. 4°.)

[2] See also *Abbe, C.*—Tornado frequency per unit area, this REVIEW, June, 1897, p. 250.—EDITOR.

[3] *Finley, John P.* The tornadoes of Kansas for 29 years, 1859–1887. J. H. Soulé, Washington, 1888. n. p. map. 16½ cm.

TABLE 2.—*List of tornadoes reported in Kansas, 1859–1887.*

[From the report of Lieut. John P. Finley, U. S. Signal Corps.]

County.	Date.	Time.
	1859.	
Franklin and Miami	June —	3 a. m.
Ottawa	June 20	Afternoon.
	1860.	
Doniphan	July 4	5 p. m.
Shawnee	July 31	5 p. m.
Marshall	July 31	3:30 p. m.
	1868.	
Doniphan	June 16	Afternoon.
	1870.	
Republic	Nov. 8	Afternoon.
	1872.	
Saline	April —	.....
	1873.	
Cloud	June 28	3 p. m.
	1874.	
Osage	Apr. 4	.....
Butler	June 22	Afternoon.
Montgomery	June 26	Afternoon.
	1876.	
Pawnee	Mar. 5	.....
Ford	Apr. 26	.....
Leavenworth	May 6	3:15 a. m.
Ford	May 13	.....
Saline	June 6	3:30 p. m.
Do	June 6	Afternoon.
Do	June 6	Afternoon.
Lincoln	June 6	Afternoon.
Saline	June 7	2:45 p. m.
Do	June 12	.....
Ford	June 13	.....
Bourbon	June 15	.....
	1877.	
Ford	Apr. 22	Afternoon.
Ottawa	May 18	Afternoon.
Saline	May 18	Afternoon.
Cloud	June 12	Afternoon.
Leavenworth	Aug. 25	Afternoon.
	1878.	
Cherokee	Mar. 1	5 p. m.
Marshall	Apr. 5	5 p. m.
Chase	Apr. 13	Afternoon.
Leavenworth	Apr. 17	Afternoon.
Leavenworth and Jefferson	May 25	4 p. m.
Marshall	May 31	5:30 p. m.
	1879.	
Brown	May 29	6 p. m.
Ottawa	May 30	3 p. m.
Do	May 30	3 p. m.
Marshall	May 30	6:30 p. m.
Do	May 30	5:30 p. m.
Ellsworth and Lincoln	May. 30	2:30 p. m.
Riley	May 30	6 p. m.
Ottawa	May 30	4 p. m.
Clay	May 30	5:30 p. m.
Cloud	May 30	3:30 p. m.
Saline	June —	6 p. m.
Ottawa	June 10	Evening.
Mitchell	June 10	Afternoon.
Leavenworth	June 10	Afternoon.
Douglas	June 10	5 p. m.
Cloud	June 12	Afternoon.
Stafford	July 28	.....
	1880.	
Cherokee	Apr. —	.....
Franklin	Apr. 2	6 p. m.
Crawford	Apr. 2	7 p. m.
Johnson	Apr. 18	4:30 p. m.
Woodson	May 9	5 p. m.
Ness	May 19	3 p. m.
Saline	June 5	.....
Lane	Aug. 15	3 p. m.
	1881.	
Smith	Mar. 10	4:15 p. m.
Cherokee	Mar. 16	Forenoon.
Do	Apr. 1	12:10 p. m.
Chase	Apr. 30	6 p. m.
Clay	May 13	Afternoon.
Woodson	May 16	.....
Lane	June 7	3 p. m.
Osborne	June 9	5:30 p. m.
Morris	June 9	5 p. m.
Ottawa and Dickinson	June 9	5 p. m.
Mitchell	June 9	4 p. m.
Lyon	June 11	4 p. m.
Sumner	June 12	4 p. m.
Osage	June 12	5 p. m.
Cowley	June 12	4:30 p. m.
Lyon and Osage	June 12	4 p. m.
Saline	Sept. 1	4 p. m.
Sumner	Sept. 29	Afternoon.
Riley	Sept. 29	6 p. m.
Nemaha	Sept. 29	6 p. m.
Dickinson	Sept. 29	About noon.
Lyon and Woodson	Sept. 29	6:30 p. m.
	1882.	
Stafford and Rice	Apr. 5	4 p. m.
Saline	Apr. 5	5:50 p. m.
Reno	Apr. 5	4 p. m.
Clay	Apr. 6	5 p. m.
Butler	Apr. 7	10:30 p. m.
Crawford	May 12	.....
Linn	June 7	4 p. m.
Anderson	June 14	3 p. m.
Greenwood	July 16	Morning.
Shawnee	Aug. 6	10:40 a. m.
Russell	Aug. 27	10:35 p. m.
	1883.	
Wabaunsee	Apr. 19	Night.
Barber	Apr. 27	11:30 p. m.
Doniphan	May 13	.....
Wyandotte and Johnson	May 13	4:30 p. m.
Labette and Cherokee	May 13	6 p. m.
Riley and Pottawatomie	June 11	10:25 p. m.
Jefferson	June 11	11:30 p. m.
Jackson	July 10	10 a. m.
Do	July 10	10 a. m.
Sumner	July 16	5 p. m.
Decatur	Aug. 14	About 3:30 p.m.
	1884.	
Anderson	Apr. 26	4 p. m.
Phillips and Smith	Apr. 26	2 p. m.
Pawnee	Apr. 28	9 p. m.
Russell	Apr. 28	5:15 p. m.
Montgomery	May 20	3:15 p. m.
Russell	May 30	4 p. m.
Jewell	June 14	.....
Do	July 12	.....
Barton	July 18	8:45 p. m.
Jewell	July 20	.....
Russell	July 26	7:15 p. m.
Scott, Lane, Hodgeman, Ford	July 26	7:15 p. m.
Shawnee	Aug. 24	.....
Montgomery	Sept. 26	.....
	1885.	
Rice	Apr. 21	2 a. m.
Mitchell	Apr. 29	4 p. m.
Rooks	May 15	4 p. m.
Kingman	May 15	5 p. m.
Phillips	May 16	4 p. m.
Kingman	May 16	6 p. m.
Nemaha	May 27	11:30 a. m.
Marshall	May 27	10:40 a. m.
Jackson	May 27	12 m.
Jefferson	May 27	12:15 p. m.
Atchison	May 27	12:30 p. m.
Kingman	June 19	1 a. m.
Leavenworth	June 20	Night.
Stafford	June 20	Evening.
Do	July 1	3 p. m.
Jewell	July 26	5 p. m.
Atchison	Aug. 5	1:25 p. m.
	1886.	
Nemaha	Apr. 14	Night.
Do	Apr. 14	4 p. m.
Jackson	Apr. 14	4 p. m.
Saline	Apr. 22	Afternoon.
Neosho	May 6	2 p. m.
Lyon	May 6	Afternoon.
Barton	May 6	Afternoon.
Neosho	May 6	4 p. m.
Jefferson	May 9	Afternoon.
Do	May 11	11 a. m.
Atchison	May 11	10:30 a. m.
Do	May 11	11:45 a. m.
Jefferson	May 14	10 a. m.
Russell	May 25	Afternoon.
Reno	July 19	6 p. m.
Finney	July 19	5 p. m.
Hamilton	Aug. 15	Evening.
	1887.	
Jewell	Feb. 17	2 p. m.
Linn	Apr. 21	5:30 p. m.
Atchison	Apr. 22	2:30 p. m.
Woodson	Apr. 22	Morning.
Anderson	May 16	2 p. m.
Clay	May 22	6:15 p. m.
Lyon	July 19	4 p. m.
Shawnee	July 21	8:40 p. m.
Graham	Aug. 4	8 p. m.
Jefferson	Aug. 4	5 p. m.
Pottawatomie	Aug. 4	5 p. m.
Cherokee	Aug. 10	6 p. m.

TABLE 3.—*List of tornadoes reported in Kansas, 1889–1896.*

From report by Prof. A. J. Henry, *in* "Report of the Chief of the Weather Bureau 1895–96."]

County.	Date.	Hour.	Loss.	
			Lives.	Property.
	1889.			
Pratt	May 6	6 p. m.		
Stafford	May 6	7:30 p. m.		
Rice	May 6	8:15 p. m.	† 3	† $8,000
Washington	May 6	11:20 p. m.	0	4,000
McPherson	May 28	2 p. m.	0	2,500
Chase	May 28	4 p. m.	1	8,000
Chautauqua	June 8	2 p. m.	0	6,000
	1890.			
Wilson	May 9	4 p. m.	2	Unknown.
	1891.			
Decatur	May 20	12:30 a. m.	0	7,500
	1892.			
Kiowa	Mar. 31	8:30 p. m.	0	15,000
Rice	Mar. 31	5:30 p. m.		
Saline	Mar. 31	6:30 p. m.		
Clay	Mar. 31	8 p. m.	† 2	† 12,000
Sumner	Mar. 31	8 p. m.		
Sumner	Mar. 31	9 p. m.		
Butler	Mar. 31	9:30 p. m.		
Butler	Mar. 31	10 p. m.	† 17	† 18,000
Marion	Mar. 31	10 p. m.		
Chase	Mar. 31	11 p. m.		
Pottawatomie	Mar. 31	Midnight.	† 11	† 25,000
Montgomery	Apr. 3	2:30 p. m.	1	(*)
Greenwood	May 13	6:50 p. m.	0	1,500
Harper and Sumner	May 27	6:30 to 9 p. m.	16	300,000
	1893.			
Linn	Apr. 11	5:30 p. m.	0	100,000
Brown	Apr. 11	4:05 p. m.	1	5,000
Osage	Apr. 12	4:30 p. m.	1	12,000
Miami	Apr. 12	7:30 p. m.	0	500
Anderson	Apr. 28	5:30 p. m.	1	1,000
Jefferson	June 21	6:30 p. m.	10	2,000
Cowley	June 21	8 p. m.	0	25,000
Pawnee	Aug. 10			1,000
Logan	Aug. 12	2 p. m.	2	1,500
	1894.			
Jewell	May 2	5:45 p. m.	0	4,000
Chase	June 25	5 p. m.	0	5,000
	1895.			
Crawford	Apr. 15	7 p. m.	1	10,000
Harvey	May 1	4:30 p. m.	8	70,000
Lyon	June 17	5:30 p. m.		15,000
Coffey	Sept. 8	3 p. m.		25,000
	1896. §			
Cloud, Clay, and Washington	Apr. 20	9 to 9:30 p. m.	8	15,000
Rice	May 11	6 p. m.	0	(*)
McPherson	May 15	4 a. m.	1	1,000
Washington, Marshall, Nemaha, and Brown.	May 17	4:30 to 8:30 p. m.	† 25	† 300,000
Cowley	May 19	4 p. m.	0	3,000
Lyon	May 20	8 p. m.	0	500
Shawnee	May 20	5 p. m.	0	2,500
Cowley	May 20	11 a. m.	0	200

† This includes totals for storms immediately preceding for which no total is given.
* Damage very small.
§ To June 30 only.

TABLE 4.—*List of tornadoes reported in Kansas, 1914 and 1915.*

[From "Monthly Reports of Climatological Data of Kansas."]

County.	Date.	Hour.	Loss.	
			Lives.	Property (estimated).
	1914.			
Rice	Mar. 28	5:30 p. m.	0	$85,000
Sumner	Apr. 17	5:30 p. m.	2	100,000
Butler	June 1		0	(*)
Smith	June 2	6:15 p. m.	0	(*)
Bourbon	Aug. 19	3 p. m.	0	(*)
Wilson, Neosho, and Greenwood#.	Oct. 9	5:30 to 6:30 p. m.		
Montgomery and Labette	Oct. 9	7:30 p. m.		
Cherokee	Oct. 9	8 p. m.	†10	†50,000
	1915.			
Wichita	June 3	6 p. m.	1	40,000
Kiowa	June 11	6:30 p. m.	0	60,000
Pottawatomie	June 17	4 p. m.	5	5,000
Coffey	June 17	5 p. m.	0	40,000
Bourbon	June 17	9 p. m.	0	50,000
Grant	June 23	3 p. m.	0	(*)
Crawford	June 30		0	2,000
Barton	Nov. 10	7:07 p. m.	11	1,000,000
Pratt	Nov. 10	8:30 p. m.	0	15,000
Sumner and Sedgwick	Nov. 10	10 p. m.	3	50,000

* Damage very small.
# Three tornadoes in succession in practically the same path.
† This includes totals for storms immediately preceding for which no total is given.

Total number of tornadoes in the 10 years 1889–1896 and 1914–15, 64; number of lives lost, 143; property loss, $2,427,200.

REFORESTATION AND OCCULT CONDENSATION.[1]

By PAUL DESCOMBES, Honorary Director of State Manufactures.

[Dated: July 28, 1914, Bordeaux, France.]

The tree has always been considered the great regulator of waters, although science has yet to translate this beneficent action into precise formulæ. There are periods when one sees entire regions laid waste by deforestation, as Algiers where the aqueducts and the hot springs of ancient cities contrast with the dried-up beds of wadies which watered them in former times, and it is only a few years since man began to penetrate the mystery which envelops the hydrologic rôle of the forest.

From the very first investigations have supported an increase of rains by reforestation, and M. Daubrée summarized them in 1910 in his report to the Commission on Floods, as follows:

The condensing action of forests has been confirmed experimentally at l'Ecole de Nancy. From a series of observations made in 1867–1899 it follows that the average quantities of rain falling in a forest and outside a forest are in the ratio of 100 to 76. Prof. Ebermayer in Germany and Blanford in India have found that the depth of rainfall has been, on the average, 12 per cent greater in a forest than on an open field.

The action of forests upon rain should not be relegated to the infinitely small meteorological data, as Cézanne says. One is justified in asserting that the presence of forests augments pluviosity, to be sure in variable measure, according to the air currents, topography, and from other causes.[2]

This increase of the annual amount of rain water, whether it be a quarter or an eighth, is far from corresponding to the amplitude of the phenomenon which transforms regions previously watered but from which the tree has disappeared, into waterless deserts, and a new way opened up to investigations when attention was drawn to the importance of atmospheric condensations not measurable by the raingage.

The majority of the works on forestry emphasize the influence of the forests upon the rainfall régime and the regulation of run-off. The trees have yet another hydrologic rôle which it is proper to put in evidence—they provoke an abundant condensation of meteoric water without rain.

In foggy weather everyone has seen numerous drops fall from the trees resulting from the condensation of the fog.

In the clearest air, also, abundant condensation is produced on the trees; dew during the night, hoarfrost and needles of all forms during days of frost.

All waters resulting from these condensations without rain reach the ground softly and successively, under the most favorable conditions for their absorption by the soil and the nourishing of springs. They are of great interest in alpine economy because they always contain ammonia even at the highest elevations and thus supply nitrogen assimilable by vegetation. In the equatorial regions, even far removed from the sea and permanent water bodies, the dew continues to form during the dry season and is abundant enough to support vegetation and to furnish water to certain animals.[3]

These diverse varieties of condensation without rain occur also on the bare soil, but their intensity is found to be considerably augmented in the forests by the expanse and high radiative power of the foliage surface.

The determinations which one might make in cold regions or at great altitudes would present a very real interest in making known the importance of these condensations without rain and the relations which they might bear to the quantity of water evaporated by the vegetation.[4]

[1] *Descombes, Paul.* Le réboisement et les condensations occultes. C.-r. Assoc. franc p. l'avancem. des sci., 43me sess. Le Havre, 1914. Notes et Mém. Paris, 1915. pp. 337–341 *Translated by* H. Lyman and C. Abbe, jr., for the MONTHLY WEATHER REVIEW.
[2] *Daubrée, L.* Rapports et documents de la Commission des Inondations. Imprimerie Nationale, Paris, 1910, p. 508.
[3] Reported by *Henri Poiter*, Captaine de l'Infanterie coloniale.
[4] *Descombes, Paul.* Sur un mode de l'action hydrologique des fôrets. Soc. des. sci. phys. et nat., Bordeaux, 17 mars 1904.